

WHAT IS CLAIMED IS:

1. A microfluidic flow cell for removably interfacing with a removable-member for performing a reaction therebetween, said microfluidic flow cell comprising:

at least one reaction portion defining with the removable-member a reaction chamber when said microfluidic flow cell and said removable-member are in an interfaced position thereof; and

at least one fluid-receiving portion for receiving a fluid therein and being in fluid communication with said reaction chamber;

wherein when in said interfaced position, said microfluidic flow cell is adapted to allow for the fluid in said fluid-receiving portion to flow to said reaction chamber.

2. A microfluidic flow cell according to claim 1, further comprising a conduit providing said fluid communication between said fluid-receiving portion and said reaction chamber.

3. A microfluidic flow cell according to claim 1, further comprising a plurality of separate fluid-receiving portions each receiving a respective fluid, each of said separate fluid-receiving portions being in fluid communication with a common said reaction chamber.

4. A microfluidic flow cell according to claim 3 further comprising a plurality of separate conduits, each said separate conduit providing said fluid communication between a respective said fluid-receiving portion and said common reaction chamber.

5. A microfluidic flow cell according to claim 4, wherein said plurality of separate conduits meet at a valve for fluid communication therewith, said valve being in fluid communication with said common reaction chamber.

6. A microfluidic flow cell according to claim 5, wherein said fluid communication between said reaction chamber and said valve is provided by a common channel.

7. A microfluidic flow cell according to claim 1, wherein said reaction portion comprises a reaction cavity.

8. A microfluidic flow cell according to claim 7, wherein said cavity comprises a structure selected from the group consisting of indentations and at least one groove.

9. A microfluidic flow cell according to claim 1, wherein said fluid-receiving portion comprises a reagent chamber, said fluid comprising a reagent.

10. A microfluidic flow cell according to claim 1, wherein said fluid-receiving portion comprises a fluid-receiving chamber formed within said microfluidic flow cell.

11. A microfluidic flow cell according to claim 1, wherein said fluid-receiving portion comprises a fluid-receiving cavity defining a fluid-receiving chamber with said removable-member when said microfluidic flow cell and said removable-member are in said interfaced position.

12. A microfluidic flow cell according to claim 2, wherein said conduit is formed within said microfluidic flow cell.

13. A microfluidic flow cell according to claim 2 further comprising a conduit cavity, said conduit-cavity defining said conduit when said microfluidic flow cell and said removable-member are in said interfaced position.

14. A microfluidic flow cell according to claim 3, wherein said at least one of said plurality of conduits is formed within said microfluidic flow cell.

15. A microfluidic flow cell according to claim 3, wherein at least one of said plurality of conduits is defined by a conduit in said microfluidic flow cell when said microfluidic flow cell and said removable member are in said interfaced position.

16. A microfluidic flow cell according to claim 5, wherein said valve is formed within said microfluidic flow cell.

17. A microfluidic flow cell according to claim 5 further comprising a valve-cavity, said valve-cavity defining said valve when said microfluidic flow cell and said removable-member are in said interfaced position.

18. A microfluidic flow cell according to claim 6, wherein said common channel is formed within said microfluidic flow cell.

19. A microfluidic flow cell according to claim 18, further comprising a common channel-cavity, said common channel-cavity defining said common channel when said microfluidic flow cell and said removable-member are in said interfaced position.

20. A microfluidic flow cell according to claim 1, further comprising a plurality of separate fluid-receiving portions, each

said fluid-receiving portion of said plurality being in fluid communication with a common canal, said common canal being in communication with said reaction chamber.

21. A microfluidic flow cell according to claim 20, wherein each said separate fluid-receiving portions comprises a pair of elongate bores meeting at a common part of said common canal.

22. A microfluidic flow cell according to claim 21, wherein said common part comprises a valve.

23. A microfluidic flow cell according to claim 20, wherein said common canal is formed within said microfluidic flow cell.

24. A microfluidic flow cell according to claim 20, further comprising a common canal-cavity, said common canal-cavity defining said common canal when said microfluidic flow cell and said removable-member are in said interfaced position.

25. A microfluidic flow cell according to claim 21, wherein said pair of elongate bores are formed within said microfluidic flow cell.

26. A microfluidic flow cell according to claim 21, wherein said elongate bored are formed by complementary elongate bore portions defined by said microfluidic flow cell and said removable-member when in said interfaced position.

27. A microfluidic flow cell according to claim 22, wherein said valve is formed within said microfluidic flow cell.

28. A microfluidic flow cell according to claim 22 further comprising a valve-cavity, said valve-cavity defining said valve

when said microfluidic flow cell and said removable-member are in said interfaced position.

29. A microfluidic flow cell according to claim 1 further comprising a dispensing portion in fluid communication with said reaction chamber.

30. A microfluidic flow cell according to claim 29, wherein said dispensing portion is in fluid communication with the external environment of said microfluidic flow cell.

31. A microfluidic flow cell according to claim 29, wherein said dispensing portion comprises a dispensing channel formed within said microfluidic flow cell.

32. A microfluidic flow cell according to claim 29, wherein said dispensing portion comprises a dispensing channel, said microfluidic flow cell further comprising a dispensing channel-cavity, said dispensing channel-cavity defining said dispensing channel when said microfluidic flow cell and said removable-member are in said interfaced position.

33. A microfluidic flow cell according to claim 1, wherein said microfluidic flow cell comprises hydrophobic material.

34. A microfluidic flow cell according to claim 1, wherein said microfluidic flow cell comprises a substrate.

35. A microfluidic flow cell according to claim 34, wherein said substrate comprises elastomeric material.

36. A microfluidic flow cell according to claim 35, wherein said elastomeric material comprises PDMS.

37. A microfluidic flow cell according to claim 1, wherein said removable-member comprises a support for performing a reaction thereon.

38. A microfluidic flow cell according to claim 37, wherein said support comprises hydrophobic material.

39. A microfluidic flow cell according to claim 37, wherein said support is functionalized to allow for the binding of probes thereon.

40. A microfluidic flow cell according to claim 37, wherein said support comprises glass.

41. A microfluidic flow cell according to claim 1, wherein said support comprises a microarray.

42. A microfluidic flow cell according to claim 41, wherein said microarray comprises bioprobe spots.

43. A microfluidic flow cell according to claim 42, wherein said bioprobe spots are selected from the group consisting of DNA, RNA, oligonucleotides, oligonucleotide analogs, proteins, peptides, organic molecules, sugars, drugs and a combination thereof.

44. A microfluidic flow cell according to claim 41 further comprising a plurality of fluid-receiving portions and a plurality of channels in fluid communication therewith, said channels being in communication with said reaction chamber.

45. A microfluidic flow cell according to claim 44, wherein said plurality of channels access individual spots of said microarray.

46. A microfluidic flow cell according to claim 44, wherein said plurality of channels access individual groups of spots of said microarray.

47. A microfluidic flow cell according to claim 1, wherein said removable-member comprises an enclosure.

48. A microfluidic flow cell according to claim 47, wherein said enclosure comprises a removable seal.

49. A microfluidic flow cell according to claim 1 being adapted to be actuated so as to provide for the fluid in said fluid-receiving portion to flow to said reaction chamber.

50. A microfluidic flow cell according to claim 49, wherein said actuation is provided by forces selected from the group consisting of: gravity, centrifuge, capillary force, centripetal force, gas-pressure, electro-osmosis, DC and AC electrokinetics, electrophoresis, electrowetting, magnetic force, acoustic force, pneumatic drive force, mechanical micropump force, positive and negative displacement force, thermal force, electrochemical bubble generation force, and combinations thereof.

51. A microfluidic flow cell according to claim 1,

wherein said fluid is initially in dry form and is adapted to be liquefied.

52. A microfluidic flow cell according to claim 1 further comprising at least one vent, said vent being in fluid communication with the ambient environment and with said reaction chamber.

53. A microfluidic flow cell according to claim 1 further comprising at least one vent, said vent being in fluid communication with the ambient environment and with said fluid-receiving portion.

54. A microfluidic flow cell according to claim 2, further comprising at least one vent, said vent being in fluid communication with the ambient environment and with said conduit.

55. A microfluidic flow cell according to claim 5, further comprising at least one vent, said vent being in fluid communication with the ambient environment and with said valve.

56. A microfluidic flow cell according to claim 18, further comprising at least one vent, said vent being in fluid communication with the ambient environment and with said common channel.

57. A microfluidic flow cell according to claim 20, further comprising at least one vent, said vent being in fluid communication with the ambient environment and with said common canal.

58. A microfluidic flow cell according to claim 29, further comprising at least one vent, said vent being in fluid communication with the ambient environment and with said dispensing

portion.

59. A microfluidic flow cell according to claim 1, wherein said removable member comprises an auxiliary microfluidic flow cell.

60. A microfluidic flow cell according to claim 1, wherein said removable-member comprises a support comprising a support cavity defining said reaction chamber when in said interfacing position, said reaction cavity comprising a fluid outlet in communication with said reaction chamber.

61. A microfluidic device comprising:

a microfluidic flow cell in combination with a removable-member;

at least one reaction chamber defined by said microfluidic flow cell and said removable-member when in an interfaced position thereof for performing a reaction therein; and

at least one fluid-receiving chamber for receiving a fluid therein and being in fluid communication with said reaction chamber;

wherein said microfluidic flow device is adapted to allow for the fluid in said fluid-receiving chamber to flow to said reaction chamber.

62. A microfluidic device according to claim 61, further comprising at least one conduit providing said fluid communication between said fluid-receiving portion and said reaction chamber.

63. A microfluidic device according to claim 61 further comprising a plurality of separate fluid-receiving portions each receiving a respective fluid, each of said separate fluid-receiving portions being in fluid communication with a common said reaction chamber.

64. A microfluidic device cell according to claim 63 further comprising a plurality of separate conduits, each said separate conduit providing said fluid communication between a respective said fluid-receiving portion and said common reaction chamber.

65. A microfluidic device according to claim 64, wherein said plurality of separate conduits meet at a valve for fluid communication therewith, said valve being in fluid communication with said common reaction chamber.

66. A microfluidic device according to claim 65, wherein said fluid communication between said reaction chamber and said valve is provided by a common channel.

67. A microfluidic device according to claim 61 further comprising a plurality of separate fluid-receiving portions, each said fluid-receiving portion of said plurality being in fluid communication with a common canal, said common canal being in communication with said reaction chamber.

68. A microfluidic device according to claim 67, wherein each said separate fluid-receiving portions comprises a pair of elongate bores meeting at a common part of said common canal.

69. A microfluidic device according to claim 68, wherein said common part comprises a valve.

70. A microfluidic device according to claim 61 further comprising a dispensing portion for dispensing portion in fluid communication with said reaction chamber.

71. A microfluidic device according to claim 70, wherein said dispensing portion is in fluid communication with the external environment of said microfluidic flow cell.

72. A microfluidic device according to claim 61, wherein said microfluidic flow cell comprises hydrophobic material.

73. A microfluidic device according to claim 61, wherein said microfluidic flow cell comprises a substrate.

74. A microfluidic device according to claim 73, wherein said substrate comprises elastomeric material.

75. A microfluidic device according to claim 74, wherein said elastomeric material comprises PDMS.

76. A microfluidic device according to claim 61, wherein said removable-member comprises a support for performing a reaction thereon.

77. A microfluidic device according to claim 76,

wherein said support comprises hydrophobic material.

78. A microfluidic device according to claim 76, wherein said support is functionalized to allow for the binding of probes thereon.

79. A microfluidic device according to claim 76, wherein said support comprises glass.

80. A microfluidic device according to claim 76, wherein said support comprises a microarray.

81. A microfluidic device according to claim 80, wherein said microarray comprises bioprobe spots.

82. A microfluidic device according to claim 81, wherein said bioprobe spots are selected from the group consisting of DNA, RNA, oligonucleotides, oligonucleotide analogs, proteins, peptides, organic molecules, sugars, drugs and a combination thereof.

83. A microfluidic device according to claim 80 further comprising a plurality of fluid-receiving portions and a plurality of channels in fluid communication therewith, said channels being in communication with said reaction chamber.

84. A microfluidic device according to claim 83, wherein said plurality of channels access individual spots of said microarray.

85. A microfluidic device according to claim 82, wherein said plurality of channels access individual groups of spots of said microarray.

86. A microfluidic flow cell according to claim 61, wherein said removable-member comprises an enclosure.

87. A microfluidic device according to claim 86, wherein said enclosure comprises a removable seal.

88. A microfluidic device according to claim 61 being adapted to be actuated so as to provide for the fluid in said fluid-receiving portion to flow to said reaction chamber.

89. A microfluidic device according to claim 88, wherein said actuation is provided by forces selected from the group consisting of: gravity, centrifuge, capillary force, centripetal force, gas-pressure, electro-osmosis, DC and AC electrokinetics, electrophoresis, electrowetting, magnetic force, acoustic force, pneumatic drive force, mechanical micropump force, positive and negative displacement force, thermal force, electrochemical bubble generation force, and combinations thereof.

90. A microfluidic device according to 61, wherein said fluid is initially in dry form and is adapted to be liquefied.

91. A microfluidic device according to claim 61 further comprising at least one vent, said vent being in fluid communication with the ambient environment and with said reaction chamber.

92. A microfluidic flow cell according to claim 61, wherein said removable member comprises an auxiliary microfluidic flow cell.

93. A microfluidic system for driving fluids, said system comprising:

at least one microfluidic device comprising:

- a microfluidic flow cell comprising at least one reaction portion and at least one fluid-receiving portion for receiving a fluid therein;
- a removable-member for interfacing with said microfluidic flow cell as to perform a reaction therebetween;
- a reaction chamber for performing a reaction therein, said reaction chamber being defined by said reaction portion when interfaced with said removable-member, said reaction chamber being in fluid communication with said fluid-receiving portion; and
- a force-providing device for providing an external force onto said microfluidic device so as to provide for the fluid in said fluid-receiving portion to flow to said reaction chamber.

94. A microfluidic system according to claim 93, wherein said removable-member comprises a support, said microfluidic flow cell being positioned on said support.

95. A microfluidic system according to claim 94, wherein said support comprises glass.

96. A microfluidic device according to claim 94, wherein said support comprises a microarray.

97. A microfluidic device according to claim 96, wherein said microarray comprises bioprobe spots.

98. A microfluidic device according to claim 97,

wherein said bioprobe spots are selected from the group consisting of DNA, RNA, oligonucleotides, oligonucleotide analogs, proteins, peptides, organic molecules, sugars, drugs and a combination thereof.

99. A microfluidic system according to claim 93, wherein said microfluidic flow cell comprises a substrate.

100. A microfluidic system according to claim 99, wherein said substrate comprises elastomeric material.

101. A microfluidic system according to claim 100, wherein said elastomeric material comprises PDMS.

102. A microfluidic system according to claim 93, wherein said a force-providing device comprises a centrifuge device.

103. A microfluidic system according to claim 102, wherein said centrifuge device comprises a rotatable platform for positioning a plurality of said microfluidic devices thereon.

104. A microfluidic system according to claim 103, wherein said platform comprises microfluidic device receiving portions.

105. A microfluidic system according to claim 104, wherein said microfluidic device receiving portions comprise slots, said removable member comprising a glass support slide to be received by said slot.

106. A microfluidic system according to claim 103, wherein said rotatable platform comprises a disc.

107. A microfluidic system according to claim 106, wherein said disc comprises a central portion for operatively

communicating with an actuator to be rotated thereby.

108. A microfluidic system according to claim 107, wherein said central portion comprises an opening, said actuator comprises a hub mounted to a motor.

109. A microfluidic system according to claim 106, wherein said disc comprises a waste reservoir positioned near the periphery thereof.

110. A microfluidic system according to claim 109, wherein said microfluidic device comprises a dispensing portion for dispensing fluid therethrough, said microfluidic device being positioned on said disc with said dispensing portion facing said waste reservoir, whereby during operation of said disc, said waste reservoir collects dispensed fluid.

111. A microfluidic system according to claim 93, further comprising a reaction detecting/analyzing device for detecting and/or analyzing the reaction occurring in said reaction chamber.

112. A microfluidic system according to claim 93, wherein said fluid comprises a reagent.

113. A method for driving fluids used in a reaction within a microfluidic structure, said method comprising:

(a) providing a microfluidic structure comprising a microfluidic flow network interfaced with a removable-member for defining a reaction chamber therebetween, said reaction chamber being in fluid communication with said network;

(b) placing at least one sample fluid product within said network and at least one reacting product in one of said network and said reaction chamber;

(c) actuating the microfluidic flow network so that products in said network are driven to said reaction chamber for providing a reaction therein; and

(d) removing at least a part of said removable-member from said network with a result of the reaction being provided on at least one of said removable-member and said network.

114. A method according to claim 113, further comprising:

(e) detecting and/or analyzing the reaction.

115. A method according to claim 114, wherein said (e) is performed before (d) so that the reaction is detected and/or analyzed within the reaction chamber.

116. A method according to claim 114, wherein the reaction is detected and/or analyzed on at least one of said removable-member and said network.

117. A method according to claim 113, wherein said at least one sample fluid product comprises a reagent.

118. A method according to claim 113, wherein said at least one sample fluid product comprises a liquid phase analyte.

119. A method according to claim 113, wherein said reacting product comprises a fluid.

120. A method according to claim 113, wherein said reacting product comprises a solid substance.

121. A method according to claim 113, wherein said reacting product comprises bioprobes.

122. A method according to claim 121, wherein said bioprobes are selected from the group consisting of DNA, RNA, oligonucleotides, oligonucleotide analogs, proteins, peptides, organic molecules, sugars, drugs and a combination thereof.

123. A method according to claim 113, wherein said removable member comprises a support, said network being interfaced on said support.

124. A method according to claim 123, wherein said placing said at least one reacting product in said reaction chamber in step (b) comprises placing said reacting product on said support prior to interfacing said network on said support thereby defining said reaction chamber.

125. A method according to claim 123, wherein the support comprises a microarray.

126. A method according to claim 123, wherein the support comprises glass.

127. A method according to claim 123, wherein said support is functionalized to covalently bind probes.

128. A method according to claim 123, wherein said support is rendered hydrophobic.

129. A method according to claim 113, wherein said network is defined by a microfluidic flow cell.

130. A method according to claim 129, wherein said microfluidic flow cell comprises a substrate.

131. A method according to claim 130, wherein said substrate comprises elastomeric material.

132. A method according to claim 131, wherein said elastomeric material comprises PDMS.

133. A method according to claim 129, wherein said microfluidic flow cell is rendered hydrophobic.

134. A method according to claim 113, wherein said at least one of said sample fluid product and said reacting product is initially provided as dry product, said method comprising liquefying said dry product prior to step (b).

135. A method according to claim 113, wherein at least one of said sample fluid product and said reacting product is initially provided as dry product, said method comprising liquefying said dry product after said placing in step (b).

136. A method according to claim 113, wherein said reaction comprises a hybridization reaction.

137. A method according to claim 113, wherein said actuating comprises subjecting the microfluidic flow network to a force selected from the group consisting of: gravity, centrifuge, capillary force, centripetal force, gas-pressure, electro-osmosis, DC and AC electrokinetics, electrophoresis, electrowetting, magnetic force, acoustic force, pneumatic drive force, mechanical micropump force, positive and negative displacement force, thermal force, electrochemical bubble generation force, and combinations thereof.

138. A method according to claim 113, wherein the network comprises a series of fluid-receiving portions from a proximal to distal position relative to the reaction chamber, said step (b) comprising placing a respective said sample fluid in each of said series of fluid-receiving portions, said actuating in step (c) causing fluid products in said series of said fluid-receiving portions to be sequentially driven to said reaction chamber from the most proximal positioned to the most distal positioned said fluid-receiving portion.

139. A method according to claim 138, wherein said actuating in step (c) comprises centrifugation, said sequential driving of fluids being caused by a progressive augmentation of centrifugation speed.

140. A method according to claim 113, wherein said actuating in step (c) comprises centrifugation.

141. A method according to claim 140, wherein said centrifugation comprises:

placing said interfaced network and removable-member on a rotatable platform; and
actuating said platform so as to apply centrifugal force on the fluid products in said network.

142. A method according to claim 141, wherein said step (c) further comprises dispensing fluid-waste from the microfluidic structure via a dispensing portion thereof.

143. A method according to claim 140, further comprising collecting fluid waste during centrifugation via a fluid-waste-collecting portion formed on the rotatable platform.